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An Answer to Four Papers of Mr. Hobs, lately Published in the Months of August, and this present September, 1671.

In the former part of his first Paper ;

BY reason of a Proposition of Dr. Wallis (*Prop. 1. Cap. 5. De Motu*) to this purpose (for he doth not repeat it *Verbatim*;) *If there be supposed a row of Quantities infinitely many, increasing according to the natural Order of Numbers, 1, 2, 3, &c. or their Squares, 1, 4, 9, &c. or their Cubes, 1, 8, 27, &c. whereof the last is given. It will be a row of as many, equal to the last, in the first case, as 1 to 2; in the second case, as 1 to 3; in the third, as 1 to 4, &c. (Where all that is affirmed, is but; If we SUPPOSE That; This will Follow. Which Consequence Mr. Hobs doth not deny: and therefore all that he saith to it, is but Cavilling.)*

Mr. Hobs moves these Questions, (and proposeth them to the Royal Society, to pass a judgment on them.) 1. *Whether there can be understood (he should rather have said, supposed) an infinite row of Quantities, whereof the last can be given.* 2. *Whether a Finite Quantity can be divided into an Infinite Number of lesser Quantities, or a Finite quantity consist of an Infinite Number of Parts.* 3. *Whether there be any Quantity greater than Infinite,* 4. *Whether there be any Finite Magnitude of which there is no Center of Gravity.* 5. *Whether there be any Number Infinite.* 6. *Whether the Arithmetick of Infinites be of any use for the confirming or confuting any Doctrine.*

For answer. In general, I say, 1. *Whether those things Be or Be not; yea, whether they Can or Cannot be;* the Proposition is not at all concerned, (which affirms nothing either way;) but, whether they can be *supposed*, or made the *supposition*, in a *conditional Proposition*. As when I say, *If Mr. Hobs were a Mathematician, he would argue otherwise;* I do not affirm that either he *is*, or ever *was*, or *will be* such. I only say (upon supposition) *If he were*, what he is not; he would not do as he doth. 2. Many of these *Quære's* have nothing to do with the Proposition: For it hath not one word concerning *Gravity*, or *Center of Gravity*, or *Greater than Infinite*. 3. That usually in *Euclide*, and all after him, by *Infinite* is meant but, *More than any assignable Finite*, though not *Absolutely Infinite*, or the greatest possible. 4. Nor do they mean, when *Infinites* are proposed, that they should

actually Be, or be *possible to be performed*; but only, that they be *supposed*. (It being usual with them, upon *supposition* of things *Impossible*, to infer useful Truths.) And *Euclide* (in his second *Postulate*) requiring, *the producing a streight line Infinitely, either way*; did not mean, that it should be *actually performed*. (for it is not possible for any man to produce a streight line Infinitely;)

but, that it be *supposed*. And if AB^* be *supposed* so produced, though but one way; its length must be *supposed* to become *Infinite* (or *more than any Finite length assignable*;) For, if but *Finite*, a Finite production would serve. But, if so produced both ways; it will be yet *Greater*, that is, *Greater than that Infinite*, or *Greater than was necessary to make it more than any Finite length assignable*. (And whoever doth thus *suppose Infinites*; must consequently *suppose, One Infinite greater than another*.) Again, when (by *Euclide's* tenth

Proposition) the same AB^* , may be *Bisected* in M , and each of the halves in m , and so onwards, *Infinitely*: it is not his meaning (when such continual section is proposed) that it should be *actually done*, (for, who can do it?) but that it be *supposed*. And upon such (*supposed*) section *infinitely continued*, the parts must be (*supposed*) *infinitely many*; for no *Finite* number of parts would suffice for *Infinite* sections. And if further, the same AB so divided, be *supposed*

the side of a Triangle ABC^* ; and, from each point of division, *supposed* lines (as $mc, Mc, \&c.$) parallel to BC : these parallels (reckoning downward from A to BC) must consequently be (*supposed*) *infinitely many*; and those, in *Arithmetical progression*, as 1, 2, 3, &c. each exceeding its Antecedent as much as that exceeds the next before it; and, *whereof the last* (BC) *is given*: (and their Squares, as 1, 4, 9, &c. their Cubes, as 1, 8, 27, &c.) And this I say, to shew that the *supposition of Infinites* (with these attendants) is not so new, or so *Peculiar* to *Cavallerius* or *Dr. Wallis*, but that *Euclide* admits it, and all Mathematicians with him; as at least *supposable*, whether *Possible* or not.

In particular, therefore, to his *Quare's*, I answer, 1. There may be *supposed* a row of Quantities *Infinitely many*, and *continually increasing*, (as the *supposed* parallels in the Triangle ABC , reckoning downwards from A to BC ,) *whereof the last* (BC) *is given*. 2. A *Finite* Quantity (as AB) may be *supposed*

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(by such continual Bisections) divisible into a number of parts *Infinitely many* (or, more than any Finite number assignable:) For there is no stint beyond which such division may not be *supposed* to be continued; (for still the last, how small soever, will have two halves;) And, all those Parts *were in* the Undivided whole; (else, where should they be had?) 3. Of *supposed* Infinites, one may be *supposed* greater than another: As a, *supposed*, infinite number of *Men*, may be *supposed* to have a Greater number of eyes. 4. A surface, or solid, may be *supposed* so constituted, as to be *Infinitely Long*, but *Finitely Great*, (the Breadth continually Decreasing in greater proportion than the Length Increaseth,) and so as to have *no Center of Gravity*. Such is *Toricellio's Solidum Hyperbolicum acutum*; and others innumerable, discovered by *Dr. Wallis*, *Monsieur Fermat*, and others. But to determine this, requires more of *Geometry and Logick* than *Mr. Hobs* is Master of. 5. There may be *supposed* a number *Infinte*; that is, greater than any assignable Finite: As the *supposed* number of parts, arising from a *supposed* Section *Infinitely continued*. 6. There is therefore no reason, on this account, why the Doctrin of *Euc'ide*, *Cavallerius*, or *Dr. Wallis*, should be rejected as of no use.

But having solved these *Quere's*, I have some for *Mr. Hobs* to answer, which will not so easily be dispatched by him. For though *Supposed Infinites* will serve the Mathematicians well enough: yet, howsoever he please to prevaricate (which, he saith, is for his Exercise,) *Mr. Hobs* himself is more concerned than they, to solve such *Quere's*. Let him ask himself therefore, if he be still of opinion, that *there is no Argument in nature to prove, the World had a Beginning*: 1. Whether, in case it had not, there must not have passed an *Infinite number of years* before *Mr. Hobs* was born. (For, if but *Finite*, how many soever, it must have begun so many years before.) 2. Whether, now, there have not passed more; that is, *more than that infinite number*. 3. Whether, in that *Infinite* (or *more than infinite*) number of *Years*, there have not been a *Greater number of Days and Hours*: and, of which hitherto, *the last is given*. 4. Whether, if this be an Absurdity, we have not then (contrary to what *Mr. Hobs* would persuade us) an *Argument in nature to prove, the world had a beginning*. Nor are we beholden to *Mr. Hobs* for this Argument; for it was an Argument in use before *Mr. Hobs* was born. Nor can he serve him-
self

self (as the Mathematicians do) with *supposed Infinites* ; For his Infinites, and more than Infinites of Years, Days, and Hours, already past, must be *Real Infinites*, and which have *actually existed*, and whereof the last is given ; (and yet there are more to follow,) Mr. *Hobs* shall do well, (for his Exercise) to solve *these*, before he propose more *Quare's* of *Infinites*. And this I say, to shew that Mr. *Hobs* is, as much as any, concerned to solve the *Quare's* by himself proposed.

In the latter part of his first Paper,

HE gives us (out of his *Roset. Prop. 5.*) this Attempt of *Squaring the Circle*, suppose DT be $\frac{2}{3}DC$, and DR a mean proportional between DC and DT : the Semidiameter DC will be equal to the Quadrantal Arc RS , and DR to TV .

That the thing is false, is already shewed in the Latin Confutation of his *Rosetum*, published in the *Philosophical Transactions* for July last past.

As it is now in the English ; his Demonstration is peccant in these words, (*Col. 2. lin. 31, 32, 33.*) *Therefore -- the Arc on TV, the Arc on RS, the Arc on CA, cannot be in continual proportion ;* (with all that follows :) There being no ground for such Consequence.

And the thing is manifest * ; for since that, by his construction, $DC.CA.$ Arc on CA extended \therefore } are in the same continual proportion, of the Semidiameter $DR.RS.$ Arc on RS extended \therefore } $DT.TV.$ Arc on TV extended \therefore } to the Quadrantal Arc ;

Let that proportion be *what you will* ; suppose, as
 * See *Tab. 1. n. V.* 1 to 2 ; and consequently, DC to CA being as 1 to 2, it will be to the Arc on CA , as 1 to 4 : And by the same reason, DR to the Arc on RS , and DT to the Arc on TV , must also be as 1 to 4 : And therefore the Arcs on TV , on RS , on CA ; that is, $4DT, 4DR, 4DC$; will be in the same proportion to one another, as (their sines) DT, DR, DC : But these (by construction) are in continual proportion ; therefore those Arcs also, as they ought to be. Indeed, if (by changing some one of the terms) you destroy (contrary to the Hypothesis) the continual proportion of DT, DR, DC , you will destroy that of the Arcs also (which are still proportional to these :) but so long as DT, DR, DC , be in any continual proportion

portion (whether that by him assigned or any other) those will be in the same continual proportion with them. As if for DT, DR, DC, be taken Dt, Dr, Dc, in any continual proportion (greater, less, or equal to his) the Arcs on *tu*, on *rs*, on CA, (extended) will be in the same continual proportion.

But (which is the common fault of Mr. *Hobs's* Demonstration) if this Demonstration were good, it would serve as well for any proposition as that for which he brings it. For if, instead of $\frac{2}{3}$, he had said, $\frac{4}{9}$, $\frac{1}{2}$, $\frac{1}{100}$, or what else he pleased; the Demonstration had been just as good as now it is, without changing one syllable: That is, it will equally prove the proportion of the Semidiameter to the Quadrantal Arc, to be, *what you please*: As any may presently see, who doth but read over his Paper.

In his second Paper,

HE pretends to confute a Theorem, which bath a long time passed for truth; (and therefore doth no more concern Dr. Wallis, than other men.) And 'tis this, *The four sides of a square being divided into any number of equal parts, for example, into 100; and streight lines drawn through the opposite points, which will divide the Squares into 100 lesser Squares: The received opinion* (saith he) *and which Dr. Wallis commonly useth, is, that the Root of those 100, namely 10, is the side of the whole Square.* Which to confute, he tells us, *The Root 10 is a number of Squares, wherof the whole contains 100; and therefore the Root of 100 Squares is 10 of those Squares, and not the side of any Square; because the side of a Square is not a Superficies, but a Line.*

For Answer I say, that 'tis neither the opinion of Doctor Wallis, nor (that I know) of any other (so far is it from being a Received Opinion, which Master *Hobs* insinuates as such) that 10 is the Root of 100 Squares (For surely a Bare Number cannot be the side of a Square Figure :) Nor yet (as Master *Hobs* would have it) that 10 Squares is the Root of 100 Squares: But that 10 Lengths is the Root of 100 Squares. 'Tis true that the Number 10 is the Root of the Number 100, but not, of a 100 Squares: and, that 10 Squares is the Root (not of 100 Squares, but) of 100 squared Squares: Like as 10 Dousen is the Root, not of 100 Dousen, but of 100 Dousen dousen, or Squares of a Dousen. And, as, there,

there, you must multiply not only 10 *into* 10, but *Doufen into Doufen*, to have the Square of 10 *Doufen*; so here 10 *into* 10 (which makes a 100) and *Length into Length* (which makes a *Square*) to obtain the Square of 10 *Lengths*, which is therefore 100 *Squares*, and 10 *Lengths* the Root or side of it. But, says he, the Root of 100 *Soldiers*, is 10 *Soldiers*. *Answer*. No such matter: For 100 *Soldiers* is not the product of 10 *Soldiers into* 10 *Soldiers*, but of 10 *Soldiers into* the Number 10; And therefore neither 10, nor 10 *Soldiers*, the Root of it. So 10 *Lengths into* the Number 10, makes no Square, but 100 *Lengths*; but 10 *Lengths into* 10 *Lengths* makes (not 100 *Lengths*, but) 100 *Squares*.

So in all other proportions: As, if the number of *Lengths* in the *Square side* be 2; the number of *Squares* in the *Plain* will be *twice two*, (because there will be *two* rows of *two* in a row:) If the number of *Lengths* in the *side*, be 3; the number of *Squares* in the *Plain*, will be 3 times 3, or the Square of 3: If that be 4, this will be 4 times 4: And so in VIII. IX. all other proportions. Of which, if any one doubt he may believe his own eyes*.

And this Mr. *Hobs* might have been taught by the next Carpenter (that knows but how to measure a Foot of Board) who could have told him, that because the *side* of a Square Foot, is 12 *Inches in Length*, the *Plain* of it will be 12 *times* 12 *Inches in Squares*: Because there will be 12 Rows of 12 in a Row.

His third Paper,

Which came out just as the Answer to the two former was going to the Press, contains, for substance, the same with his second, and the Latter part of the first: And so needs no farther Answer.

Only I cannot but take notice of his usual trade of contradicting himself. His second Paper says, *The side of a Square is not a Superficies, but a Line*: His third says the quite contrary, (Prop. 1.) *A Square root, (speaking of Quantity) is not a Line, but a Right-angle*. Other faults, falsities, and contradictions, there are a great many.

As for Instance: He tells us first, *In the natural Row of Numbers, as 1, 2, 3, 4, 5, 6, &c. every one is the Square of some number in the same Row*; (that is, of some Integer number; which

which is notoriously false.) This he contradicts in the very next words, *But Square numbers (beginning at 1) intermit first two numbers, then four, then six, &c ; so that none of the intermitted numbers is a Square number, nor hath any Square root.* (If these intermitted numbers, between 1, 4, 9, 16, &c. be not Squares how is it that every one in the whole row is a Square, and that of some Integer number ?) But this again is contradicted *prop. 2.* where 200 (one of such intermitted numbers) is made a Square, and $14\frac{4}{14}$ the Root of it.

Again ; in his *Definition* he tells us, that a Square Root multiplied into it self produceth a Square : But (*prop. 2.*) he multiplieth the Root $14\frac{4}{14}$ (not into it self, but) into 14 (a part thereof,) to make 200, which he will have to be the Square of that Root. Nor is it a meer slip of negligence in the computation, but his Rule directs to it ; *Any number given is produced by the greatest Root multiplied into it self, and into the remaining Fraction.* Whereof he gives this instance : *Let the number given be 200 Squares, the greatest Root is $14\frac{4}{14}$ Squares* (he should rather have said Lengths ; but that is a small fault with him ;) *I say, that 200 is equal to the product of 14 into it self (which is 196,) together with 14 multiplied into $\frac{4}{14}$ (which is equal to 4 :) that is $14\frac{4}{14}$ multiplied into 14.* But this calculation is again contradicted in his third proposition, where he calculates the same Square otherwise, as we shall see by and by. In the mean time let's consider this alone, and see the contradictions within it self. His Rule bids us multiply the greatest Root into it self, &c. This greatest Root he says is $14\frac{4}{14}$; yet doth he not multiply this, but 14 (a part thereof) into it self and into the Fraction $\frac{4}{14}$. Again ; if $14\frac{4}{14}$ be the greatest Root, what shall be the remaining Fraction ? Doth he take the Root of 200 to be more than $14\frac{4}{14}$ by some further remaining Fraction ? If so, he should have told us what that Fraction is ; for $\frac{4}{14}$ it is not, this being part of his greatest Root $14\frac{4}{14}$. But if we should allow (as I think we must,) that by the greatest Root he means sometimes $14\frac{4}{14}$, sometimes 14, (that is, if we allow him to contradict himself,) yet how comes he by the Fraction $\frac{4}{14}$? For, $\frac{2}{14}$ is too much (the square of $14\frac{2}{14}$ being more then 200, as by multiplying $14\frac{2}{14}$ into it self will appear ;) which destroys his whole design ; for 14, multiplied into $14\frac{2}{14}$, will not make 200, but 198 ; contrary to his rule. But further, it is so gross a mistake, to make 200 the Square of $14\frac{2}{14}$, that every Apprentice

boy, (that can but multiply whole numbers, and fractions,) could have informed him better, who would first have reduced the fraction to smaller terms, putting $14\frac{2}{7}$ for $14\frac{4}{14}$, and then multiplying $14\frac{2}{7}$ into it self, would have shew'd him, that the Square of $14\frac{4}{14}$, that is, $14\frac{4}{14}$ multiplied into it self, is (not 200, but) $204\frac{4}{49}$.

But the Root of 200, is the ^{ur} said number $10\sqrt{2}$, which is less than $14\frac{2}{10}$, and bigger than $14\frac{2}{15}$: the Square of that being somewhat more than 200; and, of this, somewhat less; but either of them within an unite of it.

$$\begin{array}{r} 14\frac{2}{7} \\ 14\frac{2}{7} \\ \hline 56 \end{array}$$

But this second Proposition, is (as I said) contradicted by his third, which makes the Square of $14\frac{4}{14}$ to be $200\frac{4}{49}$, (by what computation, we shall see by and by;) and then finds fault, that this and the former do not agree. (But 'tis no wonder they should disagree, when both are false.) *The same Square* (saith he) *calculated Geometrically, consisteth* (by Euclid. 2.4.) *of the same numeral great Square 196, and of two Rectangles under the greatest side 14 and the Remainder of the side, and further of the Square of the less segment; which altogether make* $200\frac{4}{49}$. (He might have learned to reckon better; but let us see how he makes it out.) *As by the operation it self* (saith he) *appeareth thus: The side of the greater segment is* $14\frac{4}{14}$ (this was, but now, the side of the whole square, how comes it now to be but the side of the greater Segment?) *which multiplied unto it self* (saith he) *makes* 200: (no; but $204\frac{4}{49}$;) *The product of 14 the greatest Segment into the two Fractions* $\frac{4}{14}$ *is* 4, *and that added to 196 makes* 200: (if by two fractions $\frac{4}{14}$, he mean, as he ought by his Rule, the Fraction 4 twice taken, or the double of it, it will be not 4, but 8, and this added to 196 make 204; But all this he puts in his pocket, for it comes not into account at all.) *Lastly, the product of* $\frac{2}{14}$ *into* $\frac{2}{14}$, *or* $\frac{1}{7}$ *into* $\frac{1}{7}$ *is* $\frac{1}{49}$; which with the first 200 makes $200\frac{1}{49}$: (But he forgets himself, for his lesser segment was not $\frac{2}{14}$, but $\frac{4}{14}$; he should therefore have said $\frac{4}{14}$ into $\frac{4}{14}$, or $\frac{2}{7}$ into $\frac{2}{7}$, is $\frac{4}{49}$.) His calculation therefore should have been this: The greater segment is (not $14\frac{4}{14}$, but) 14; which multiplied into it self makes (not 200, but 196: The Rectangle of the greater segment 14, into the lesser $\frac{4}{14}$, is 4: And this taken a second time, is another 4: The lesser segment (not $\frac{2}{14}$, but) $\frac{4}{14}$, or $\frac{2}{7}$, multiplied into it self, is

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(not $\frac{1}{9}$, but) $\frac{4}{9}$: All which added together make not $200\frac{1}{9}$, but $196 + 4 + 4 + \frac{4}{9} = 204\frac{4}{9}$, which is juſt the ſame with $14\frac{2}{14}$ multiplied into it ſelf. So that, had he known how to multiply a number into a number, eſpecially when incumbered with fractions (which it is manifeſt he doth not,) he would have found no diſagreement between the *Arithmetical calculation*, and what he calls the *Geometrical*. But I am aſhamed (for him) that ſo great a pretender to ſuch high things in Geometry, ſhould be ſo miſerably ignorant of the common operations of practical Arithmetick.

His repeated Quadrature he now expreſſeth thus, *The Radius of a Circle is a mean Proportional between the Arc of a Quadrant and two fifths of the ſame.* But inſtead of *two fifths*, he might as well have ſaid the *half, or tenth, or hundredth part, &c*; or (taking T in DC produced beyond C,) the *double, decuple, centuple, &c.* or *what you pleaſe*: For his Demonſtration would have proved it, which is this. *Deſcribe a Square ABCD, and in it a Quadrant DCA. In the ſide DC (continued it need be,) take DT two fifths of DC, (or its Half, Double, Hundredth part, or what you pleaſe;) and between DC and DT a mean proportional DR; and deſcribe the Quadrantal Arcs RS, TV. I ſay, the Arc RS is equal to the ſtreight line DC. For ſeeing the proportion of DC to DT is duplicate of the proportion of DC to DR, it will be alſo duplicate of the Proportion of the Arc CA to the Arc RS, and likewiſe duplicate of the Proportion of the Arc RS to the Arc TV. Suppoſe ſome other Arc, leſs or greater than the Arc RS, to be equal to DC, as for example rs; Then the proportion of the Arc rs to the ſtreight line DT will be duplicate of the proportion of RS to TV, or DR to DT, which is abſurd; becauſe DR is by conſtruction greater or leſs than DR. Therefore the Arc RS is equal to the ſide DC; which was to be demonſtrated.* Which demonſtration therefore proving indifferently every proportion, doth not indeed prove any. In brief: The force of his Demonſtration is but this; *DT being to DC as 2 to 5 (or in any other proportion) and DR a mean proportional between them; RS will be ſo between TV and CA; and therefore rs (greater or leſs than RS,) will not be a mean proportional between TV and CA: which is true; but why it may not be equal to DC, we have nothing but his word for it; there being nothing to ſhew, that DC is equal to ſuch a mean proportional.* Again; though rs be not a mean proportional between TV and CA, yet it may be between tv and CA, which ſerves his Demonſtration as well;

which is indifferent to any three continual proportionals, as was shewed before. So that now we have had three Demonstrations of this Quadrature, (in his *Rosetum*, in his *first* paper, and in his *third*,) and this common fault in all of them, that they equally prove the proportion by him proposed, or any other what you please. But such his Demonstrations use to be.

And this is what I thought fit to say to Mr. *Hobs's* ^{three} ~~Four~~ Papers (rather to satisfy the importunity of others, than because I thought them worth Answering :) And submit the whole, with all Respects, to the *Royal Society*, to whom Mr. *Hobs* makes his Appeal.

His Fourth Paper;

WHICH came out since the *Three* former were answer'd, (containing some faint endeavors to re-assert some things in them,) is but meer Trifling, or worse than so.

What he would therein insinuate concerning God (that we may as well prove *Him* to have had a Beginning, as that the World had) (smells too rank of Mr. *Hobs*. We are not to measure Gods *Permanent* Duration of Eternity, by our *successive* Duration of Time : Nor, his Intire Ubiquity, by Corporeal Extension.

What in it concerns *Mathematicks*, (whether his own or others,) is so weak and trivial, (and said only, that he may seem to say something, though nothing to the purpose,) that I shall trust it with those to whom he makes his appeal, without thinking it to need any Reply ; The view of what he writeth against, being a sufficient Answer to all he saith.

New Observations of Spots in the Sun ; made at the Royal Academy of Paris, the 11, 12 and 13th of August 1671 ; and English't out of the French, as follows.

IT is now about twenty * years since, that Astronomers have not seen any considerable *Spots* in the Sun, though before that time, since the Invention of Telescopes, they have from time to time observed them. The Sun appeared all that while with an entire brightness, and Signor *Cassini* saw him so the ninth of this month of *August*.

* See Numl. 74. p. 2216 ; whence it will appear, that some such Spots were seen here in London, A. 1660. And Mon^r. *Picard* affirm'd to Dr. *Fogelius* at Hamburg, that he had seen one in October 1661. witness the said Doctor's own Letter, written to the Publisher August 14th last.

Fig. I.

